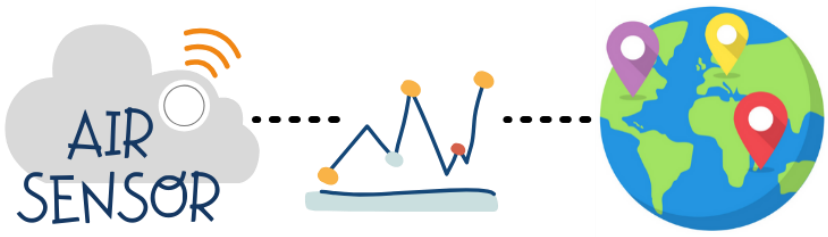
So you are thinking about using a **Personal Air Sensor**.



Technology surrounding air quality sampling instrumentation has seen a recent push towards the development of low-cost personal air sensors (PAS). Compared to traditional regulatory methods, these low-cost sensors (<$2,500) offer an opportunity for the community to explore interests in local air quality. PAS are a way to observe local air quality trends for educational and research purposes. These low-cost sensors are considered non-regulatory, meaning that the data they collect lacks sufficient quality to make inferences on compliance with national air quality standards. However, when they are sited and operated properly, the data collected from these devices become more meaningful. PAS vary widely in their quality of data and may be influenced by coexisting environmental conditions. Data collected and supported by well-placed sensors that are properly maintained can yield results that are representative of local air quality trends. This document is intended to provide guidance for maximizing data quality and data interpretation while offering additional resources for the use of stationary outdoor air quality sensors.

Step 1. What to Consider When Choosing your PAS

An increasing number of PAS are now available for purchase; however, not all sensors are the same. Different models offer various options and features. The more you know about the sensor you choose, the more confidence you may have in your data. Consider the following questions before purchasing your sensor:

What is your budget? Purchase costs for personal air sensors can range up to $2500. Remember to include maintenance, lifespan, and replacement figures when calculating the cost.
Which pollutants? Devices may measure one or multiple air pollutants. Determine which pollutants are important to you. If you are interested in dust or smoke, consider a sensor that measures particulate matter.
What area do you want to represent? A single air sensor in your yard may represent your neighborhood, but not air quality across town. Consider purchasing multiple air sensors for better representation of larger areas.
How accurate is the sensor? Sensors vary widely in accuracy. Before your purchase, consult manufacturer manuals and independent sources. Refer to experts to compare sensor performance such as levels of detection and rate of response. Some sensors are impacted by other air pollutants and conditions (e.g. temperature or relative humidity).
Is maintenance needed? To ensure better quality data, sensors may need regular cleaning. If possible, regularly scheduled calibrations promote accurate data. Determine if there is a known lifespan for your sensor.
Is there a user manual? A complete and informative user manual is important to ensure proper operation and maintenance of your sensor.
How are data stored? Determine how you will download the data and in which format the data is available. Determine if you will need additional resources to interpret the output.

Step 2. How to Choose a Location for your PAS

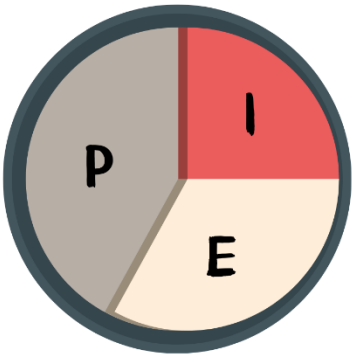
Are the logistics available? Select a location with access to power and/or wireless internet connection if needed for your sensor.

What pollutant are you sampling? Determine if there might be any activities that influence your sensor's measurements (i.e. nearby grill, idling vehicle, campfire, distance from roadway).

What area are you trying to represent? To represent human breathing height, place the sensor 2-15 meters above ground level.

Do you wish to examine a single pollution source or overall air quality trends? Carefully determine the location so that you are aware of air pollution sources that may influence your measurements. Consider local wind directions.

Are there any barriers that block air flow? Aim for unrestricted airflow for 270° around the sensor. Placement should be ≥2 meters from walls if possible and ≥10-20 meters from trees taller than the inlet.



PLAN– Define your question. What are you trying to learn? Write down your plan. Include a timeline, maintenance schedule, how you will download and analyze your data. Schedule routine visits to your sampling location to confirm proper operation of your sensor and any changes at your site.

IMPLEMENT– Complete your plan. Document your activities using a bound notebook and permanent ink. Record any maintenance or unusual events. Include the date, your initials, recent and current weather, and any actions during your visit.

EVALUATE– Examine your data for completeness and unusual outlier events. Compare your results to a nearby regulatory monitor. If collocated, apply any necessary corrections to your data. Mean and standard deviation are useful for describing trends. Carefully interpret your data. Convert concentrations to the Air Quality Index to understand health standards.

Step 3. Steps for Collecting Quality Data

Collocation is a quality control technique by which multiple air sensors, regulatory instruments, or both operate during the same time and at the same location to compare device measurements. Collocation of air quality sensors is recommended to understand the accuracy and precision of your sensor. A comparison of multiple air sensors can occur anywhere and provide insight into reliability between sensors of the same type. A comparison between air sensors and regulatory instruments provides information on the accuracy of the sensor with federal quality assured methods. In Mecklenburg County, these comparisons can be made using the Community Science Station located at the Garinger High School Air Quality Monitoring Site. If it is possible, collocation should be used throughout the duration of your study. If this is not possible, collocation should be completed before and after the study occurs and across representative weather conditions.

ACCURACY- Does your personal air sensor read the same as a nearby federal reference method?

PRECISION- Does your personal air sensor read the same as other personal air sensors of the same manufacturer?

Step 4: Understanding Your Results

It is important to review your data for accurate and complete data. Remove any outliers, or extreme values that are much smaller or larger than most of the other data collected over the duration of the study. Analyzing multiple sensors can produce large quantities of data that can be difficult to process and organize for analysis. The EPA Macro Analysis Tool is a spreadsheet based program that provides a template for inputting and comparing sensor data over time. The Air Quality Index (AQI) is a color-coded index for reporting daily air quality. It designates air quality levels that relate to researched health-based standards for EPA Criteria Pollutants: ground-level ozone, particle pollution, carbon monoxide, sulfur dioxide, and nitrogen dioxide. The daily AQI for an area is designated by the criteria pollutant with the highest Index Value. For each of these pollutants, EPA has established national air quality standards to protect public health. Most sensors do not produce an AQI value; therefore, an AQI Calculator will be needed to convert raw concentrations, or use the conversion table below to better understand your sensor's output. For short term personal air sensor data, check out the Sensor Scale.

AQI Category	Index Values	O_3 (ppb) 8-Hour Average	$PM_{2.5}$ ($\mu g/m^3$) 24-Hour Average	PM_{10} ($\mu g/m^3$) 24-Hour Average	CO (ppm) 8-Hour Average	SO_2 (ppb) 1-Hour Average	NO_2 (ppb) 1-Hour Average
Good	0 – 50	0.0 – 54	0.0 - 12.0	0 – 54	0.0 – 4.4	0 – 35	0 – 53
Moderate	51 – 100	55 – 70	12.1 – 35.4	55 – 154	4.5 – 9.4	36 – 75	54 – 100
Unhealthy for Sensitive Groups	101 – 150	71 – 85	35.5 – 55.4	155 – 254	9.5 – 12.4	76 – 185	101 – 360
Unhealthy	151 – 200	86 – 105	55.5 – 150.4	255 – 354	12.5 – 15.4	186 – 304	361 – 649
Very Unhealthy	201 – 300	106 – 200	150.5 – 250.4	355 – 424	15.5 – 30.4	305 – 604(2)	650 – 1249
Hazardous	301 – 500	201 – 604(1)	250.5 – 500.4	425 – 604	30.5 – 50.4	605 – 1004(2)	1250 – 2049

(1) Values based on 1-Hour Average readings; (2) Values based on 24-Hour Average readings

ADDITIONAL RESOURCES

Mecklenburg County Air Quality
(704)-336-5430
WebAQ@MecklenburgCountyNC.gov

EPA Data Request Form for Collocation
www.aqs.epa.gov/api

Air Sensor Guidebook, detailed EPA document designed to assist those interested in using low-cost air quality sensor technologies.
Air Quality Sensor Performance Evaluation Center (AQ-SPEC), a division of California's South Coast Air Quality Management District that provides objective performance results for personal air sensors.
Environmental Protection Agency Air Sensor Toolbox, EPA resource that provides the latest science on the performance, operation and use of air sensor monitoring systems.
EPA Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring, siting requirements for placement of federal regulatory air monitoring instrumentation.